

Sphagnum of the Pacific — a checklist

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Abstract

Six species of *Sphagnum* are recorded for the Pacific and the origin of another, *Sphagnum seemannii* var. *weberi* supposed to come from Samoa, is questioned. Five species are rejected from the area due to recent taxonomic work. *Sphagnum* is only recorded from Fiji, Hawaii and New Caledonia, in addition to the questionable report from Samoa. The occurrences of *Sphagnum* are restricted to larger, older islands, with enough precipitation for a cloud forest type of vegetation and to those islands with high altitude crater lakes.

Introduction

The *Sphagnum* flora of the Pacific (sensu Brummitt 2001; Fig. 1) has not received much attention and many reports are old. The Hawaiian archipelago is the only relatively well studied area in the region with several recent bryological collections. New Caledonia has also received some recent attention while Fiji and Samoa (and most other islands in the Pacific) have received very little recent attention (cf. von Konrat et al. 2011).

The most recent list with distribution data including *Sphagnum* in the Pacific region is by Miller et al. (1978). They report eight taxa from Fiji, New Caledonia, Hawaii and Samoa and no *Sphagnum* are recorded for any other islands in the Pacific. Of the taxa they report, we treat two in a narrower sense, *S. compactum* as *S. wheeleri* and *S. cristatum* as *S. leratianum* (both of which they had included as synonyms). We treat *S. seemannii* as a synonym of *S. cuspidatum* var. *subrecurvum* as per Eddy (1977) and question the origin of the original specimen of *S. seemannii* var. *weberi*. Finally we show that *S. reichardtii* never has been found in the region.

The Pacific *Sphagnum* taxa belong to four of the commonly accepted sections of the genus: sect. *Sphagnum* (*S. leratianum*, *S. palustre*, *S. vitjianum*), sect. *Rigida* (*S. wheeleri*), sect. *Cuspidata* (*S. cuspidatum*) and sect. *Subsecunda* (*S. novo-caledoniae*). According to the present taxonomic treatment four of the species are endemic: *S. leratianum* and *S. novo-caledoniae* to New Caledonia, *S. vitjianum* to Fiji and *S. wheeleri* to Hawaii. However, *S. leratianum* and *S. vitjianum* are probably conspecific with more widespread taxa (see notes below).

Sphagnum peatlands in the Pacific are generally small compared to those in the boreal regions. With the exception of *S. palustre* in the Kohala mountains of Hawaii, where it forms mats in restricted montane bog communities, *Sphagnum* in this region generally grows immersed at the edge of lakes and in swamps (Bartram 1936) or on shaded to partially shaded moist rocks or silty soils, near streams in forested valleys (Iwatzuki 1986). In most cases *Sphagnum* occurs above 500 m altitude on the windward slopes where high orographic rainfall and low evapotranspiration rates prevents the occurrence of prolonged annual dry seasons (Whinam et al. 2003). *Sphagnum* is absent from many islands of the Pacific due to their small area and lack of habitat. However, dispersal constraints can probably explain its absence from islands with adequate age, area, altitude and precipitation pattern as shown by the different *Sphagnum* floras of the islands of Maui and Hawaii (Karlin & Andrus 1995). Combination of adequate altitude and rainfall exists in the Marquesas archipelago (islands of Hivoo and Fatuhuku) (Whittier 1973). Upolu (Samoa) and some of the crater lakes on Vanuatu islands also seem possible for *Sphagnum* due to their altitude, pH, depth and surrounding vegetation, yet no species have been reported from there (Schabetsberger et al. 2009).

Methodology and materials

This checklist is arranged in alphabetic order. The list is in three parts, i) accepted reports, ii) doubtful reports, iii) excluded taxa. Finally, a list of all synonyms connected to reports from the Pacific is provided.

Each accepted taxon is qualified using a four level ranking system that indicates our level of confidence about a taxon's value. The coding convention is outlined in detail by von Konrat et al. (2010). Briefly,

- ? = problem with the taxon name (invalid, illegitimate, orphaned);
- * = serious doubts about the value of the taxon;
- ** = probably a good taxon;
- *** = accepted, a good taxon as currently understood.

We distinguish between first hand reports ("A report citing a specimen or an observation of material either in the field 'and then locality fairly exact' or among collected specimens") using bold font and second hand reports, ("Merely citing a locality that is not exact enough to be searched for the species, and not apparently based on a specimen that can be found"), using normal font (cf. von Konrat et al. 2010). The list includes all types coming from the Pacific region as defined by Brummitt (2001).

There are reports of *Sphagnum* from New Caledonia (NWC), both from the north and the south provinces (NWC-NO and NWC-SO); from Fiji (FIJ), Ovalau (FIJ-OV), Taveuni (FIJ-TA) and Viti-Levu (FIJ-VI); Hawaii (HAW), Hawaii I (HAW-HA), Maui (HAW-MA) and Oahu (HAW-OA); and from Samoa (SAM).

The occurrence of species in the Pacific and on each of the islands where *Sphagnum* has been recorded is shown in Table 1. Of the 12 taxa that have been reported to occur on these islands we accept six, question the occurrence of *S. seemannii* var. *weberi* on Samoa as well as its taxonomic value and reject five taxa from the area. See further notes under each taxon.

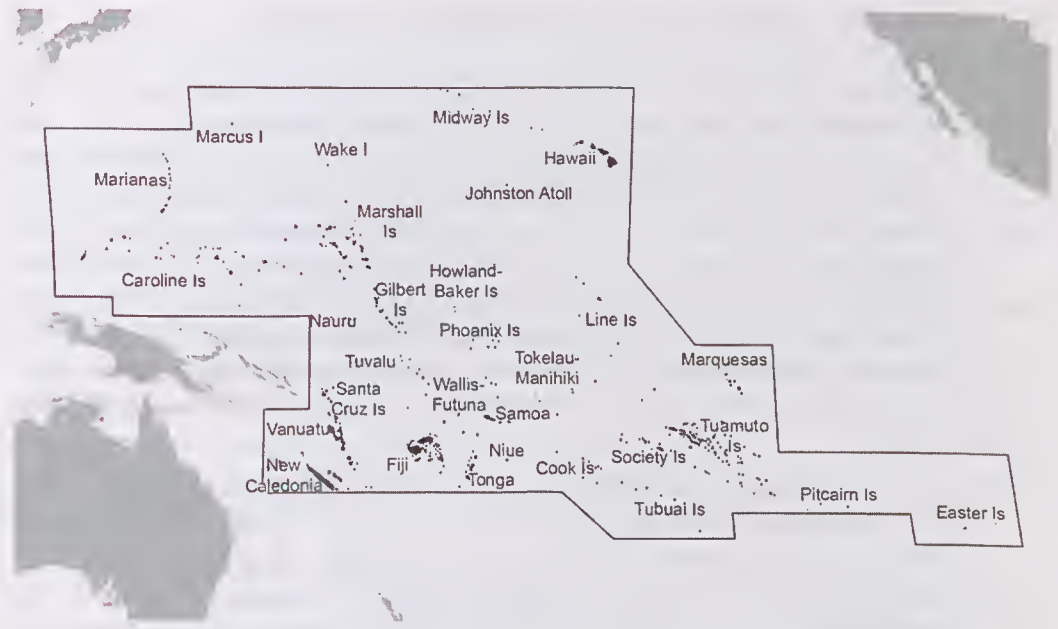


Fig. 1. Outline of the Pacific region as defined by Brummit et al. 2001.

Table 1. *Sphagnum* taxa reported from the Pacific Islands.

Abbreviations: FIJ – Fiji; OV – Ovalau; TA – Taveuni; VI – Viti Levu; HAW – Hawaii; HA – Hawaii Island; MA – Maui; OA – Oahu; NWC – New Caledonia; NO – New Caledonia North province; SO – New Caledonia South province. – rejected taxon; ●, ○ – first hand report (species and subtaxa, respectively); ? doubtful collection site; () – introduced.

	Pacific	Fiji				Hawaii				New Caledonia			Samoa
		FIJ	OV	TA	VI	HAW	HA	MA	OA	NWC	NO	SO	SAM
<i>S. compactum</i>	—					—		—					
<i>S. cristatum</i>	—									—			
<i>S. cuspidatum</i>	●	●	●	●		—		—		—			—
- subsp. <i>cuspidatum</i>	—												
-subsp. <i>subrecurvum</i>	○	○	○	○									
<i>S. henryense</i>	—					—							
<i>S. leratitanum</i>	●												●
<i>S. novo-caledoniae</i>	●									●	●	●	
<i>S. palustre</i>	●	—			—	●	●		(●)				
<i>S. perichaetiale</i>	—	—			—	—				—			
<i>S. reichardtii</i>	—	—			—								
<i>S. seemanii</i> var. <i>weberi</i>	?												?
<i>S. vitjianum</i>	●	●				—							
<i>S. wheeleri</i>	●					●		●					

Sphagnum taxa occurring in the Pacific

- *** *S. cuspidatum* Ehrh. ex Hoffm. PACIFIC: Wijk & Margadant 1967 as *S. capillaceum* var. *cuspidatum*, Wijk & Margadant 1967 as *S. palustre* var. *cuspidatum*, Wijk & Margadant 1967 as *S. capillifolium* var. *cuspidatum*, Wijk & Margadant 1967. FII: Mitten 1861, Mitten 1873. NWC: Miller et al. 1978, Pursell & Reese 1982, Whinam & Hope 2005, Thouvenot & Bardat 2010. HAW-MA: Miller et al. 1978 rejected previous reports as *S. compactum*. **NOTE**: 1) We are not aware of any first hand reports of *S. cuspidatum* or any of its infrataxa from New Caledonia prior to Miller et al. (1978). 2) We do not know on what Miller et al. (1978) based their statement on the occurrence in Hawaii of *S. cuspidatum* and we do not think it has ever been recorded from there.
- ** — subsp. *subrecurvum* (Warnst.) A.Eddy PACIFIC: Wijk & Margadant 1967 as *S. seemannii*. FII: Müller 1874 as *S. seemannii* ["*seemanni*"], Warnstorf 1901 as *Sphagnum seemannii* ["*seemanni*"], Paul 1924 as *S. seemannii*, Schultze-Motel 1973a as *S. seemannii*, Whittier 1975 as *S. seemannii*, FII-OV: **TYPE** of *S. seemannii*, Müller 1874 as *S. seemannii* ["*seemanni*"], Warnstorf 1911 as *S. seemannii*, Dixon & Greenwood 1930 as *S. seemannii*, FII-TA: Bartram 1936 as *S. seemannii* ["*seemanni*"], Eddy 1977, Miller et al. 1978 as *S. seemannii*, Whinam & Hope 2005 as *S. seemannii*. SAM: Paul 1924 as *S. seemannii*, Whinam & Hope 2005 as *S. seemannii*. **NOTE**: All reports from Samoa refer to *S. seemannii* var. *weberi* that we here exclude from the synonymy of *S. cuspidatum* (see below). *S. cuspidatum* should thus be rejected from Samoa until it is clear that this variety also belongs to *S. cuspidatum*.
- * *S. leratianum* Paris et Warnst. PACIFIC: Wijk & Margadant 1967. NWC: Paul 1924 ["*Le Ratianum*"], NWC-SO: **TYPE**, Brotherus 1911a, Warnstorf 1911 ["*Le Ratianum*"]. **NOTE**: This taxon has sometimes been synonymised with *S. perichaetiale* (Eddy 1977, Crum 1984) and sometimes with *S. cristatum* (Wijk & Margadant 1967, Whinam 2003, Whinam & Hope 2005), possibly following Andrews (1951) who discussed its relationships with other taxa in sect. *Sphagnum*. We have not studied it, so we recognise it for now, assuming that it will be synonymised when studied further. It is currently only reported from New Caledonia.
- *** *S. novo-caledoniae* Paris et Warnst. PACIFIC: Wijk & Margadant 1967. NWC: Paul 1924, Miller et al. 1978, Pursell & Reese 1982, Whinam & Hope 2005, Thouvenot & Bardat 2010, NWC-NO: **SYNTYPE**, Warnstorf 1911, Iwatsuki 1986, NWC-SO: **LECTOTYPE**, Brotherus 1911a, ["*Novae Caledoniae*"] Warnstorf 1911, Eddy 1977, Iwatsuki 1986.
Endemic to New Caledonia.
- *** *S. palustre* L. PACIFIC: Wijk & Margadant 1967 as *S. lonchocladum*, Wijk & Margadant 1967 also as *S. cymbifolium*, *S. antarcticum* var. β *lonchocladum*, McQueen et Andrus 2006. FII: Andrews 1951 [with *S. vitianum* as a synonym], Gangulee 1969, Schultze-Motel 1973 [with *S. vitjanum* as a synonym], ?Sharp et al. 1994, FII-VI: Miller et al. 1978 [with *S. vitianum* as a synonym],

Whinam & Hope 2005. HAW: **TYPE** of *S. lonchocladum*, Müller 1896a as *S. lonchocladum*, Andrews 1951, Schultze-Motel 1962, Gangulee 1969, Crum 1980, Crum 1984, Sharp et al. 1994, Whinam & Hope 2005, HAW-HA: **Bartram 1942**, Degener et al. 1969, Hoe 1978, **Karlin & Andrus 1995** also as *S. henryense* Warnst., Staples et al. 2004, **Waite 2007**, HAW-OA: Miller et al. 1978, **Karlin & Andrus 1995**, **Karlin 2001** [introduced from Hawaii I. in the 1960's], **Waite 2007** ["Introduced as it was used as bedding for forestry seedlings"]. **NOTE**: 1) All reports from Fiji are due to the inclusion of *S. vitjianum* as a synonym and have to be rejected. 2) *S. henryense* has been reported from Hawaii, but later rejected as a misidentification of *S. palustre* (Karlin 2001, Staples et al. 2004, Waite 2007). Recently, Karlin et al. (2010) showed that *S. henryense* and *S. palustre* are conspecific using microsatellite data. However, they did not include any specimens from the Pacific area in the analysis. If the Hawaiian material cannot be included in *S. palustre* s.l., but proves to be a species in its own right, then the correct name would be *S. lonchocladum* Müll.Hal. (Karlin 2001).

- * *S. vitjianum* Schimp. ex Warnst. PACIFIC: Wijk & Margadant 1967, FIJ: **TYPE**, Warnstorf 1901 ["*vitianum*"], Paul 1924 ["*vitianum*"], Dixon & Greenwood 1930, Whittier 1975, HAW-OA: Hoe 1978. **NOTE**: 1) *S. vitjianum* is sometimes treated as a synonym of *S. palustre* (Andrews 1951) and sometimes of *S. perichactiale* (Eddy 1977) and Karlin (2001) mentions that it is "either *S. perichactiale* or a closely related species". We prefer to keep it as an accepted taxon until further studies clarify its status. 2) All reports of *S. vitjianum* from Hawaii are rejected as *S. palustre* (Karlin & Andrus 1995, Karlin 2001, Staples et al. 2004). See note under *S. palustre*. Endemic to Fiji.
- ** *S. wheeleri* Müll.Hal. PACIFIC: Wijk & Margadant 1967 also as *S. wheeleri* var. *vulcanicum*, *S. rigidulum* and *S. vulcanicum*. HAW: **TYPE** of *S. rigidulum*, **TYPE**, **Müller 1887**, **Warnstorf 1890** as *S. rigidulum*, Müller 1896a, Warnstorf 1901 also as *S. vulcanicum*, Paul 1924, HAW-MA: **TYPE** of *S. vulcanicum*, **Warnstorf 1900** as *S. vulcanicum*, Degener et al. 1969, **Karlin & Andrus 1995**, **Karlin 2001**, Staples et al. 2004. Endemic to Hawaii.

Taxa doubtfully occurring in the Pacific

- ? *S. seemannii* Müll.Hal. var. *weberi* (Warnst.) Warnst. PACIFIC: Wijk & Margadant 1967 also as *S. weberi*. SAM: **TYPE** of *S. weberi*, **Warnstorf 1890** as *S. weberi*, Schultze-Motel 1973a, Miller et al. 1978. **NOTE**: *S. seemannii* is a synonym of *S. cuspidatum* subsp. *subrecurvum* (Eddy 1977) but it is unclear what var. *weberi* is. The type of *S. weberi* was reported from "Samoa, am See 'Draunu' zwischen Gleichenien circa 1400 m hoch im September 1881 leg. Weber" (Warnstorf 1890) but neither Schultze-Motel (1973a) nor we have been able to find a locality on Samoa that it could come from. In fact, only the island of Savai'i is high enough for the report, but that island does not have any lakes above 1300 m. We have not been able to find where Weber collected in 1881 and

where there could possibly be a locality like this. However, we are rather sure that it is not on Samoa and would guess that is in New Guinea as both Samoa and part of New Guinea were German colonies at this time.

Taxa rejected from the Pacific

- *** *S. compactum* Lam. et DC. **PACIFIC**: Séneca & Söderström 2009, **HAW**: Crum 1986, Hill et al. 1992, Fife 1996, **HAW-MA**: Miller et al. 1978, Crum 1984. **NOTE**: Karlin (2001) and Staples et al. (2004) reject all reports from Hawaii as *S. wheeleri*.
- ** *S. cristatum* Hampe **NWC**: Miller et al. 1978, Whinam & Hope 2005. **NOTE**: The only report refers to *S. leratianum*, a taxon sometimes considered a synonym of *S. cristatum* (Wijk & Margadant 1967, Whinam 2003, Whinam & Hope 2005). See note under *S. leratianum*.
- ** *S. cuspidatum* subsp. *cuspidatum* **PACIFIC**: Séneca & Söderström 2009. **NOTE**: This was erroneously reported as the subspecies instead of the species.
- ** *S. perichaetiale* Hampe **FII**: Eddy 1977 [incl. *S. vitjianum* as a synonym], Seppelt 2006. **NWC**: Pursell & Reese 1982, Thouvenot & Bardat 2010, **NWC-SQ**: Eddy 1977 [with *S. leratianum* as a questioned synonym], Iwatsuki 1986. **NOTE**: 1) Reports from Fiji are based on *S. vitjianum* being considered synonymous with this taxon (Eddy 1977). 2) Reports from New Caledonia are based on *S. leratianum* being regarded as synonymous (Eddy 1977, Crum 1984). 3) Karlin & Andrus (1995), Karlin (2001) and Staples et al. (2004) reject all reports from Hawaii, considering them to be *S. palustre*. See also note under *S. vitjianum*. 4) *S. perichaetiale* must be rejected from the Pacific until the nomenclature and systematics of this group have been further investigated.
- ** *S. reichardtii* Hampe ex Warnst. **FII**: Paul 1924, Dixon & Greenwood 1930, Schultze-Motel 1973a, Whittier 1975, Miller et al. 1978, **FII-VI**: Whinam & Hope 2005. **NOTE**: Warnstorf (1890) included the report of *S. acutifolium* Ehrh. by Mitten (1873) in his new species *S. reichardtii* from St. Paul I., in the southern Indian Ocean. The specimen of "*S. acutifolium*" was collected by G. W. Milne (no. 22) on the expedition to the South Pacific with HMS Herald 1852-1861. The early collection number indicates that it was collected long before reaching the main destination and it is close to other Milne's collection numbers from St. Paul I., so the origin is almost certainly correct. In his *Flora Vitiensis* Mitten (1873) reported many taxa from places other than Fiji. Several later authors overlooked the locations given by Mitten and assumed them all to be from Fiji. All reports of *S. reichardtii* from South Pacific are based on this mistake. In addition, Whinam & Hope (2005) interpreted the word "Viti" in Warnstorf (1891) and Dixon & Greenwood (1930) as the island of Viti Levu while it is referring to the old name used for the whole Fijian Archipelago, thus erroneously giving it a too precise location.

Synonyms

- Sphagnum antarcticum* var. \equiv *lonchocladum* (Müll.Hal.) Warnst. = *S. pahustre*
Sphagnum capillaceum var. *cuspidatum* (Ehrh. ex Hoffm.) Wahlenb. = *S. cuspidatum*
Sphagnum capillifolium var. *cuspidatum* (Ehrh. ex Hoffm.) Brid. = *S. cuspidatum*
Sphagnum cymbifolium (Ehrh.) Hedw. nom. inval. = *S. pahustre*
Sphagnum henryense Warnst. = *S. pahustre*
Sphagnum lonchocladum Müll.Hal. = *S. pahustre*
Sphagnum pahustre var. *cuspidatum* (Ehrh. ex Hoffm.) Lilj. = *S. cuspidatum*
Sphagnum rigidulum Warnst. = *S. wheeleri*
Sphagnum seemannii Müll.Hal. = *S. cuspidatum* subsp. *subrecurvum*
Sphagnum vulcanicum Warnst. = *S. wheeleri*
Sphagnum weberi Warnst. \equiv *S. seemannii* var. *weberi*
Sphagnum wheeleri var. *vulcanicum* (Warnst.) Warnst. = *S. wheeleri*

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